566.38683CX1

REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 31 to recite that a crystallite of the cerium oxide particles has a crystal grain "boundary", and has a maximum diameter not larger than 600 nm. Claim 32 has been amended to recite "a" crystallite of the cerium oxide particles. Claim 43 has been amended to recite "any" medium, rather than "said" medium, in view of lack of prior recitation of a medium; and claims 47 and 48 have been amended to recite the method of polishing a "predetermined" substrate, in light of parent claim 46. Also, various of the claims have been amended for consistency in grammar.

In view of amendment of claim 32 to recite "a crystallite", it is respectfully submitted that the rejection of claim 32 as set forth in the second paragraph on page 2 of the Office Action mailed October 20, 2004, is moot.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims in the Office Action mailed October 20, 2004, that is, the teachings of the U.S. patents to Sasaki, et al., No. 5,775,980, and to Bonneau, et al., No. 5,994,260, under the provisions of 35 USC §102 and 35 USC §103.

Initially, Applicants note with thanks the indication that the subject matter of claims 31, 32, 34, 42-45 and 47 would be allowable if set forth in independent form. Note the last paragraph on page 3 of the Office Action mailed October 20, 2004. It is respectfully submitted, however, that claim 31 is already in independent form. Accordingly, it is respectfully submitted that claim 31 should be allowed.

In any event, and as will be discussed infra, it is respectfully submitted that all of the presently pending claims patentably distinguish over the teachings of the applied prior art, within the meaning of 35 USC §102 and §103, such that the subject matter of, inter alia, claims 32, 34, 42-45 and 47 need not be set forth in independent form, in order to be allowed.

It is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such an abrasive, or such method of polishing a predetermined substrate or manufacturing method of a semiconductor device including the step of polishing using an abrasive, wherein the abrasive includes cerium oxide particles, the particles having, inter alia, a crystal grain boundary. Note, inter alia, claims 30, 46 and 49.

Furthermore, it is respectfully submitted that these references would have neither taught nor would have suggested such abrasive as in the present claims, having features as discussed previously in connection with claim 30, and, moreover, wherein the cerium oxide particles have pores (see claim 33), or has a porosity of from 10-30% (see claim 34), or has a pore volume of from 0.02 to 0.05 cm^3/g (see claim 35).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such abrasive as in the present claims, having features as discussed previously in connection with, e.g., claim 30, and, moreover, wherein the cerium oxide particles have a bulk density not higher than 6.5 g/cm^3 (see claim 36); and/or wherein the abrasive further includes a medium which is water (see claim 37) or a dispersant (see claim 38); and/or the diameter of the cerium oxide particles as in claim 41.

The present invention is directed to an abrasive, and use of such abrasive for polishing, e.g., in the manufacture of a semiconductor device.

Conventionally, in fabricating semiconductor devices, colloidal silica type abrasives have been used as chemical mechanical abrasives for smoothing inorganic insulating film layers such as SiO_2. Such abrasives, however, cannot provide a sufficient rate of polishing.

Moreover, cerium oxide abrasives have been used as glass surface abrasives for photomasks. However, when cerium oxide abrasives, used as glass surface abrasives for photomasks, are used in the polishing of inorganic insulating films, they have so large a primary particle diameter as to scratch, on polishing, the insulating film surface.

Against this background, Applicants provide a cerium oxide abrasive avoiding prior art problems, and, in particular, providing a relatively high polishing rate without scratching of the surface being polished. Applicants have found that by utilizing cerium oxide particles having grain boundaries, the high polishing rate is achieved without scratching the surface. As described in the paragraph bridging pages 7 and 8 of Applicants' specification, by carrying out the polishing using the abrasive containing crystal grain boundaries, it is presumed that the particles are broken by the stress at the time of polishing to bring about active surfaces, which surfaces are considered to contribute to high-rate polishing without scratching the polishing target surfaces of SiO_2 insulating films or the like.

Sasaki, et al. discloses a polishing method for semiconductor fabrication, in particular a polishing method for conductor films. See column 1, lines 12-15. The polishing method includes the steps of forming a film to be polished on a substrate

having a recessed portion in its surface so as to fill at least the recessed portion, and selectively leaving the film to be polished behind in the recessed portion by polishing the film by using a polishing solution containing polishing particles and a solvent, and having a pH of 7.5 or more. See column 3, lines 1-7. In an additional aspect disclosed in Sasaki, et al., the film is polished by using a polishing agent containing a solution for etching the film to be polished, a corrosion inhibitor of the film to be polished, and polishing particles. See column 3, lines 12-15. Note also column 4, lines 59-67; the paragraph bridging columns 5 and 6; the paragraph bridging columns 6 and 7; column 7, lines 13-15; and column 10, lines 53-61. This patent discloses, in a first embodiment, that as a polishing agent a colloidal solution prepared by dispersing SiO_2 particles in a dilute solution of piperazine was used. Note column 5, lines 34-36. This patent further discloses, in a second embodiment, a polishing method wherein a film is polished by using particles consisting of an organic polymer compound or particles containing at least carbon as a main constituent, as polishing particles. Note column 12, lines 23-27.

As seen in the foregoing, as well as from a full review of Sasaki, et al., it is respectfully submitted that this reference does not disclose, nor would have suggested, such abrasive or such method as in the present claims, including, inter alia, wherein the particles have a crystal grain boundary; and/or the other aspects of the present invention as discussed in the foregoing.

The contention by the Examiner in the last paragraph on page 2 of the Office Action mailed October 20, 2004, that Sasaki, et al. teaches an abrasive including cerium oxide particles "having a crystal grain boundary", is respectfully traversed. It is noted that the Examiner refers to specific portions of columns 5, 6 and 10 of

Sasaki, et al. It is respectfully submitted that these portions of Sasaki, et al. are silent with respect to the particles having a crystal grain boundary. It is respectfully submitted that Sasaki, et al. does not disclose, nor would have suggested, the particles having crystal grain boundaries, and advantages thereof as in the present invention.

It is respectfully submitted that the secondary reference applied by the Examiner, Bonneau, et al., would not have rectified the deficiencies of Sasaki, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Bonneau, et al. discloses a cerium oxide with pores having a lamellar structure (see column 1, lines 6-8), the cerium oxide particles preferably having an average particle size in the range of 10-50 μm (see column 2, lines 21 and 22). Note also column 1, lines 53-56, disclosing that the structure of the pores of the cerium oxide described therein are lamellar, in the form of slits or channels with a substantially constant diameter. This patent discloses that the cerium oxide described therein can be used in different applications, in particular as a filler, pigment or as a constituent of glass polishing compositions, and in particular as a catalyst or part of the composition of a catalytic system. See column 3, lines 52-56.

Even assuming, arguendo, that the teachings of Bonneau, et al. were properly combinable with the teachings of Sasaki, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed abrasive and method of use of an abrasive, wherein the abrasive includes cerium oxide particles having a crystal grain boundary, among other features.

566.38683CX1

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

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Respectfully submitted,

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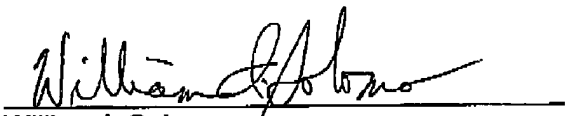
By 

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